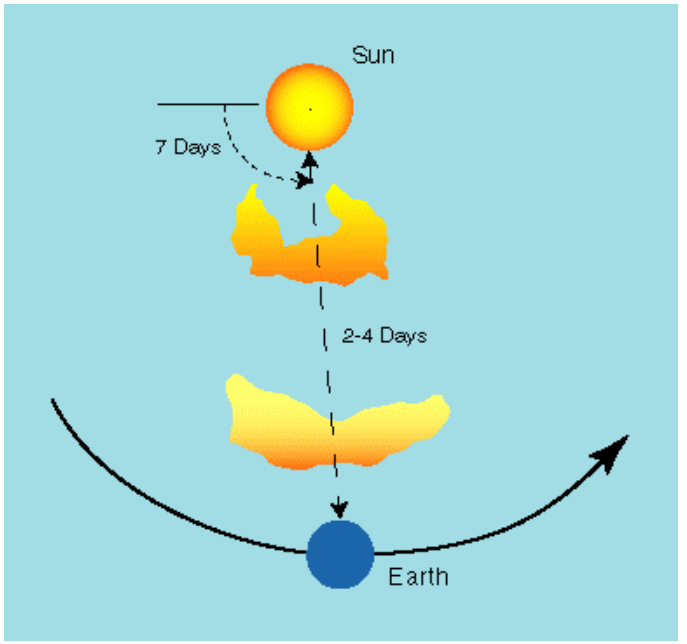
Heliospheric Science



All particles originating on the Sun have to travel through the inner heliosphere to reach and affect the Earth's magnetospheric system. Therefore, in order to increase both the accuracy and the lead time of space weather predictions, it is essential to reach a high level of understanding of the character and evolution of the inner heliosphere and structures traveling within it. While high-energy particles travel the one astronomical unit distance between the Sun and Earth in a matter of minutes to hours, large-scale solar wind structures [e.g., coronal mass ejections (CMEs) and co-rotating interaction regions (CIRs)] take 2 to 4 days to reach Earth. One goal of LWS is to gain an understanding of the physical processes in the heliosphere that determine the evolution of solar wind structures, and hence increase the accuracy and lead time of space weather forecasting.

Heliospheric Science Research Objectives

- Determine the ambient structure and long-term (solar cycle) variation of the inner heliosphere. All solar wind structures of space weather importance travel in this ambient background. Currently it is known that the undisturbed inner heliosphere is highly structured (two magnetic polarity hemispheres, low-latitude streamer belt with high-latitude, high-speed solar wind) and that this structure changes significantly throughout the solar cycle. The goal of LWS is to quantify these changes in order to provide the correct background for structure propagation studies.
- Determine how large-scale solar wind structures evolve in the inner heliosphere as they travel to Earth. It is the aim of this research to connect solar observations of structure liftoff with the arrival of geo-effective events at the Earth's magnetosphere. Once solar wind structure propagation and evolution is understood, it will become possible to predict which solar ejecta will impinge on Earth and how geo-effective they will be.
- Determine what solar dynamic processes are responsible for the release of geo-effective events by tracing observed heliospheric structures back to their origins. Special emphasis will be placed on determining how and where energetic particles are released and accelerated. By tracing geo-effective structures back to their solar origins, it will become possible to understand and forecast the emergence and liftoff of these potentially destructive events.